

.

:

:

12

1 cm

blood volume, CBV),  
sit time, MTT)

(cerebral blood flow, CBF),  
(time to peak, TTP)

(cerebral  
(mean tran -

가

가

CBV, CBF, MTT, TTP

MTT TTP

.

: 12

가

MTT TTP

12 8

CBF 가 가

, MTT

:

가

가가 가

,

.

(diffusion weighted MR imaging, DWMRI)

(1 -

가

3).

4 - 6

PET

가

가 ,

. MRS

가 (1 - 3).

가 ,

가

(computed tomography, CT) 24 ,

(1). Xenon CT

(magnetic resonance imaging, MRI) 12

(1, 3).

(1, 3). SPECT

10 -

20

(artifact)

(1,

, Xenon CT,  
(single photon emission computed tomography, SPECT),

3). DWMRI

(positron emission tomography, PET),

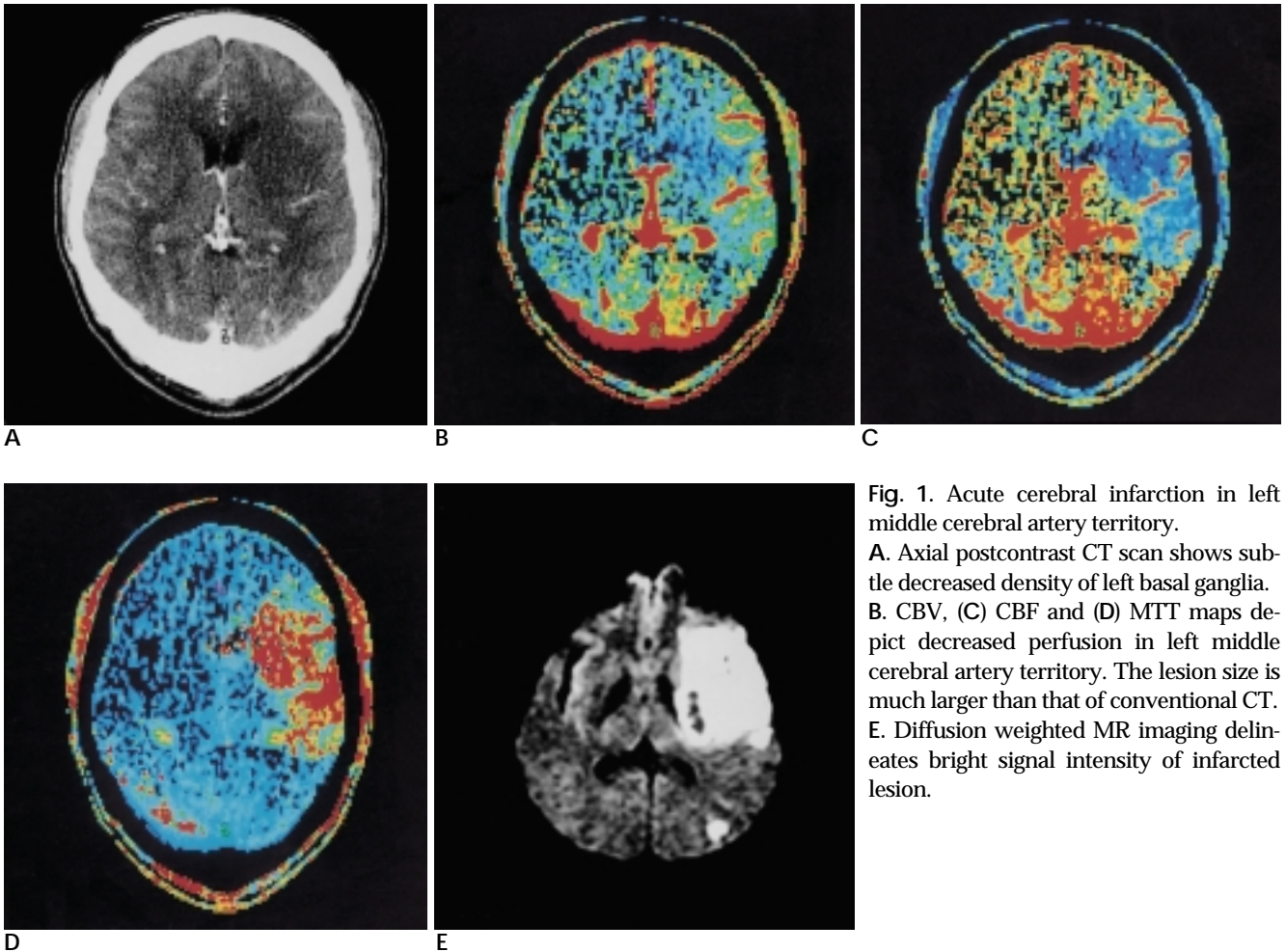
, 3

(MR spectroscopy, MRS),

(echo planar imaging)

(1, 3). DWMRI

가 (mean transit time, MTT)  
가 (time to peak, TTP)  
MRI 가 가 (3).  
. DWMRI (4-7). , DWMRI MRI CT 가  
DWMRI 가 (8).  
(3-7).  
(perfusion CT (swelling), 4-10 Hounsfield Unit  
weighted MR imaging, PWMRI) CT (hyperdense MCA or ICA sign),  
가  
12  
가 (7, 8). , CT  
CT가 (1-3, 9-12). 12 9 , 3 , 66  
(cerebral blood volume, (50-85 ) CT  
CBV), (cerebral blood flow, CBF), 11 (4-25 ) , DWMRI



**Fig. 1.** Acute cerebral infarction in left middle cerebral artery territory.  
**A.** Axial postcontrast CT scan shows subtle decreased density of left basal ganglia.  
**B.** CBV, **(C)** CBF and **(D)** MTT maps depict decreased perfusion in left middle cerebral artery territory. The lesion size is much larger than that of conventional CT.  
**E.** Diffusion weighted MR imaging delineates bright signal intensity of infarcted lesion.

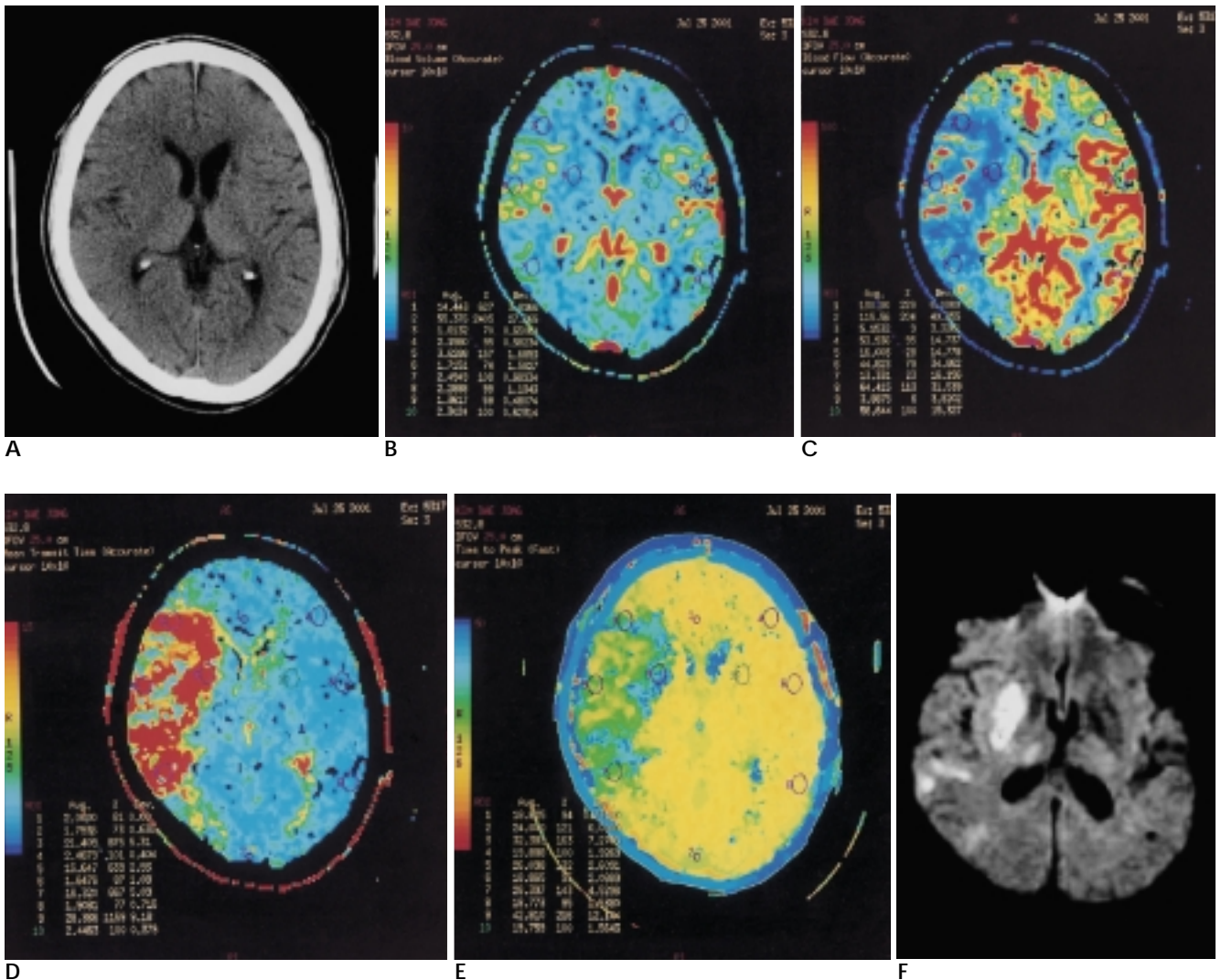
CT 24  
CT Light Speed QX/i (GE Medical Systems, Milwaukee, U.S.A.)  
80 kVp, 210 mA, 12  
CT 1, 10 mm, 120 kVp, 210 mA, 1 cm, 40 ml (Ultravist 370, Schering, Erlangen, Germany)  
4 ml 10 9 60 120 120  
CT AW 4.0

Workstation (GE Medical Systems, Milwaukee, U.S.A.)  
CBV, CBF, MTT, TTP  
가 가

**Table 1.** Time to Peak (TTP) and Mean Transit Time (MTT) Delay between Infarcted Lesion and Normal Contralateral Region

Delayed Time	Number on MTT	Number on TTP
5 sec	3	2
10 sec	4	7
15 sec	3	2
20 sec	2	1
Total	12	12

MTT: mean transit time, TTP: time to peak



**Fig. 2.** Acute cerebral infarction in right basal ganglia and temporo-occipital area.

A. Axial precontrast CT scan shows no abnormality.

B. CBV, (C) CBF, (D) MTT and (E) TTP maps depict decreased perfusion in right middle cerebral artery territory.

F. MR scan was obtained after twenty hours. The patient was treated by thrombolytic drugs. Diffusion weighted MR imaging delineates bright signal intensity of infarcted lesion. The lesion size of four perfusion CT maps are measured larger than that of diffusion weighted MR imaging.

가 . TTP (region of interest, ROI)

1.5 T (Signa Horizon, GE Medical Systems, Milwaukee, WI, U.S.A.) bird cage 5 mm, matrix 256 × 192, (field-of-view) 22 cm

T1 (TR/TE=500 msec/8 msec) , CT 가 DWMRI

T2 (TR/TE=3,500 msec/100 msec) 가 3 , 5%

DWMRI echo planar imaging x, y, z 가 . DWMRI

TR/TE 10,000/96 msec, matrix 가 가

128 × 128, b 1,000 sec/mm<sup>2</sup>, 5 mm . CT 가 DWMRI

CT CBV, CBF, MTT, TTP 가 가 DWMRI

가 가 , MTT 가 Fisher's Exact Test

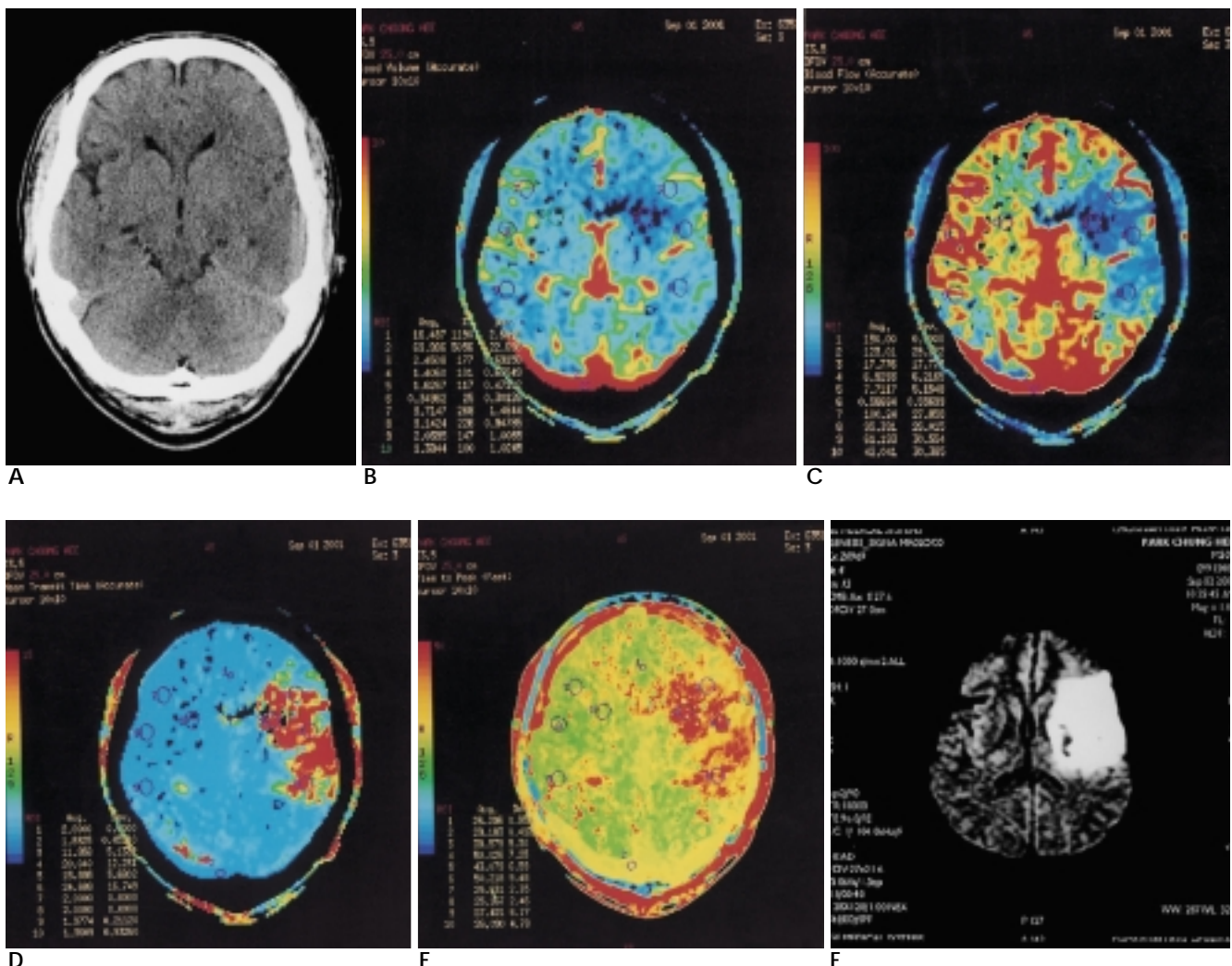


Fig. 3. Acute cerebral infarction in left middle cerebral artery territory.  
A. Axial precontrast CT scan shows obliteration of left sylvian cistern.  
B. CBV, (C) CBF, (D) MTT and (E) TTP maps depict decreased perfusion in left middle cerebral artery territory.  
F. Diffusion weighted MR imaging delineates bright signal intensity of infarcted lesion. The lesion size of MTT map is measured larger than that of diffusion weighted MR image. But, the lesion size of CBF map is measured same as that of diffusion weighted MR imaging.

12 CT 8  
(67%) 4  
CBV, CBF, MTT, TTP 가  
(100%) (Fig. 1 - 3).  
MTT TTP  
MTT 8.6 (2 - 16 ), TTP 8.8  
(4 - 19.5 ) (Table 1). 가  
DWMRI 12 CT 가  
DWMRI CBF 12 8  
가 (Table 2, 3, Fig. 1, 3), 4  
. CBV 7 , 4  
. MTT 9 3  
(Table 2, 3, Fig. 1 - 3). TTP 8 , 3  
(Table 2, 3, Fig. 2, 3). DWMRI  
CBF 가 MTT TTP  
( $p < 0.05$ ), CBV  
가 .

**Table 2.** Comparison of Lesion Size between Perfusion CT and Diffusion Weighted MR Imaging

Patient Number	Location	Lesion size on CBV, CBF, MTT, TTP map, DWMRI
1	Rt	MTT= TTP= CBF > CBV > DWMRI
2	Rt	MTT= CBF= DWMRI > CBV > TTP
3	Lt	MTT > CBF > TTP > DWMRI > CBV
4	Rt	MTT > TTP > CBF= CBV= DWMRI
5	Lt	MTT= TTP > CBF= CBV= DWMRI
6	Lt	MTT > TTP > CBF= CBV= DWMRI
7	Rt	MTT= TTP= CBF > DWMRI > CBV
8	Rt	MTT= TTP > CBF= CBV= DWMRI
9	Rt	MTT > TTP= CBF= DWMRI > CBV
10	Lt	MTT > TTP > CBF > CBV= DWMRI
11	Lt	MTT= TTP= CBF= CBV= DWMRI
12	Lt	MTT= TTP= CBF= CBV= DWMRI

Rt: right, Lt: left, CBV: cerebral blood volume,  
CBF: cerebral blood flow, MTT: mean transit time  
TTP: time to peak, DWMRI: diffusion weighted MR imaging

**Table 3.** Lesion Size of Four Methods of Perfusion CT Maps Compared with Diffusion Weighted MR Imaging

	CBV	CBF	MTT	TTP
Larger	1	4	9	8
Same	7	8	3	3
Smaller	4	0	0	1
Total	12	12	12	12

CBV: cerebral blood volume, CBF: cerebral blood flow  
MTT: mean transit time, TTP: time to peak

CT  
(multi - detector) CT 가  
CT가 CT  
(3). data  
CBV, CBF, MTT, TTP 가  
(3, 9 - 14).  
가  
Na+/K+ pump 가  
Na+가 (1, 5, 15 - 17).  
DWMRI  
, 가  
(4, 7).  
DWMRI CT  
가 CT 가  
12  
CT 가 가 . 4 CT  
CT  
(ischemic penumbra) (3 -  
5, 15 - 17). CT CBV, CBF, MTT, TTP  
가 (1 - 4).  
CBV , , , , ,  
ml/100 g 100 g  
. CBV  
가  
7 DWMRI  
1 , 4  
(2, 4, 13).  
CBF , , , , ,  
ml/min/100 g , 100 g 1  
. CBF  
(1, 2).

12, 4, 8 DWMRI 가 가 , , 4 DWMRI . CT 1-2 CBF, CBV, TTP, MTT CT 가 (1-4). 가 가 MTT 가 . MTT 가 가 가 , (6, 14). 12 9 DWMRI CT가 가 가 가 가 CT DWMRI 12 CT CBV, CBF, MTT, TTP 가 DWMRI 1. 12 CT 가 , DWMRI 12 . 2. MTT TTP . 3. DWMRI 12 8 DWMRI CBF 가 가 (p < 0.05, Fisher's Exact Test). 4. MTT 가 DWMRI CT 가 , 가가 가 CT가 . (9-12, 18-20). 가 MTT (2, 4). 6 MTT , 4 MTT 가 가 . TTP (4). TTP (2, 4, 8). CBF MTT TTP , (2, 8). 5 CT (2, 3, 13). , CT CBF 89% (1), CBF 100% 가 (2). CT 가 가 , , CT MRI 24 가 가

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## The Usefulness of Perfusion CT in Acute Cerebral Ischemic Infarction<sup>1</sup>

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**Purpose:** To determine the usefulness of cerebral perfusion computed tomography (CT) in patients with acute cerebral ischemic infarction.

**Materials and Methods:** Twelve patients with acute middle cerebral artery infarction underwent conventional CT and cerebral perfusion CT within 25 hours of the onset of symptoms. For each patient, perfusion CT scans were obtained at the levels of the basal ganglia and 1 cm caudal to them. Using special imaging software, perfusion imaging maps for cerebral blood volume (CBV), cerebral blood flow (CBF), mean transit time (MTT), and time to peak (TTP) were created, and the infarcted lesion was evaluated on each map. MTT and TTP delay times were measured in the perfusion defect lesion and symmetric contralateral normal cerebral hemisphere. Lesion size on each perfusion map was determined and compared with the value obtained by diffusion-weighted MR imaging (DWMRI).

**Results:** In all patients, perfusion CT maps depicted the perfusion defect lesion, for which the MTT and TTP delay was remarkable. A comparison of lesion size between each perfusion map and DWMRI images showed that the closest correlation involved CBF maps (8/12, 67%). On MTT maps, the lesion was larger than at DWMRI, suggesting that MTT mapping can be used to evaluate ischemic penumbra.

**Conclusion:** Perfusion mapping facilitates the evaluation not only of the ischemic core and ischemic penumbra, but also of hemodynamic status in the area of the perfusion defect. This finding demonstrates that perfusion CT can be useful for the diagnosis and treatment of patients with acute cerebral ischemic infarction.

**Index words :** Magnetic resonance (MR), diffusion study  
Computed tomography (CT), perfusion study  
Brain, infarction

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